

Distribution and Abundance of Pacific Herring (*Clupea pallasii*) Spawn Deposition for Cherry Point, Washington stock, 1973-2004.

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Abstract

Once the largest in Washington state waters, the Cherry Point herring stock has experienced a dramatic decline in abundance since quantitative sampling began in 1973. Spawning biomass estimates decreased from 15,000 tons in 1973 to a low of 800 tons in 2000; the 2004 estimate was 1,700 tons. The stock is currently under consideration for listing as threatened or endangered under the Federal Endangered Species Act.

Herring spawn deposition surveys have been conducted by the Washington Department of Fish & Wildlife (WDFW) and tribal co-managers on the Cherry Point stock's spawning grounds since 1973. The basic procedure involves grappling bottom vegetation and converting lineal distances of observed spawn intensities to an estimate of spawning escapement. Surveyed locations are recorded by GPS coordinates or plotted on field charts. Data collected include marine vegetation observed, depth range, presence/absence of spawn and estimated spawn intensity.

WDFW recently developed a spatial and temporal database of herring spawn deposition survey data collected for the Cherry Point stock. This database, coupled with GIS technologies, provides a valuable tool for illustration and analyses of changes and trends in spawning activity and abundance. Examples of relevant uses of the database include spawning location and biomass by year, location of marine vegetations over time, and within-season spawning locations.

Introduction

The Cherry Point, Washington herring stock has experienced a dramatic decline in abundance since quantitative assessment began in 1973. Total spawning biomass (spawning escapement plus fishery landings) has decreased from 14,998 tons in 1973 to a low of 808 tons in 2000 (Fig. 1). The stock is currently under consideration for listing as threatened or endangered under the Federal Endangered Species Act.

Microsatellite DNA studies conducted by the Washington Department of Fish & Wildlife (WDFW) indicate that the Cherry Point herring stock is distinct from several other Puget Sound stocks, while the other sampled Puget Sound stocks were not demonstrated to be genetically distinct from each other (Small et al. 2004). Analyses of microsatellite DNA variation of British Columbia herring populations also suggests that the Cherry Point stock is genetically distinct from sampled B.C. populations (Beacham et al. 2002).

The Cherry Point herring stock is one of eighteen that regularly spawn at locations throughout Puget Sound (Fig. 2). The Cherry Point stock's documented spawning grounds are found from the U.S./Canada border southward to Hale Pass (Fig. 3). However, the shoreline used for spawn deposition has decreased with stock size and most spawning activity in recent years has been between Cherry Point and Birch Bay. The stock's spawning timing is later than others in Washington, with peak spawning typically occurring in early May compared to late January to early April for other stocks (Fig. 4).

The precipitous reduction in stock size and potential ESA listing has increased interest in analyses of all available data relating to the Cherry Point herring stock. Since 1973, WDFW and tribal co-managers have conducted herring spawn deposition surveys to document spawning locations and to estimate spawning biomass for fishery management and habitat protection purposes. Spawn deposition surveys provide a direct estimate of herring spawning escapement. Marine vegetation on spawning grounds is sampled for spawn density and location of spawn deposition, and these data are converted to an estimate of spawning escapement.

Prior to this current effort, the location, timing, and amount of spawn deposition and estimated spawning escapement for the Cherry Point herring stock has not been readily available. Therefore, WDFW has developed a spatial and temporal database of herring spawn deposition survey data collected for the Cherry Point stock. This database, coupled with Geographic Information Systems (GIS) technologies, provides a valuable tool for illustration and analyses of changes and trends in spawning activity and abundance of the Cherry Point herring stock and is the basis of this report.

Methods

Herring spawn deposition survey methodology is described by Stick (1994). Spawning escapement biomass is estimated from observed spawn deposition using spawn intensity conversion factors based on Hourston et al (1972) and described by Trumble et al (1977) and Meyer and Adair (1978).

Survey data are collected by location (historically recorded on a chart; collected by Global Positioning System (GPS) receiver since 2001) including vegetation (to genus) sampled, depth range sampled, and presence (with estimated spawn intensity) or absence of herring spawn. Spawning dates are backcalculated by embryonic staging of deposited eggs.

A database was created from original survey data forms and charts from 1973-2004. The database consists of a total of 56,118 sample stations (vegetation grabs) and related spawn ages. Collected survey data were first entered into an Excel spreadsheet. The location (latitude /longitude) of sample sites prior to 2001 were recreated in MapInfo 7.0; collected GPS data used from 2001 to present. These locations were exported and combined with other survey data to make final Excel file. A separate file was made for each individual year. These “final files” were then brought into ArcGIS/ArcMap 9.0. The resulting database is maintained in DBF format, supporting display of data in numerous ways. The total effort required five person-months including system design and maintenance, data entry and reconciliation, mapping, and compiling.

Results

A series of annual maps depicting spawning escapement by location and estimated spawning escapement were created. To clearly illustrate the observed decrease in both stock size and shoreline used for spawn deposition a series of four maps were produced that each combine 8 years of survey results for 1973-2004 (Fig. 5-8). Other presentations of the database, such as location of observed vegetation types over time and within season spawning timing and location are now possible.

Discussion

The Cherry Point herring stock ‘s decline is significant on many levels. In addition to supporting commercial fisheries, herring are an important component of the marine ecosystem and are a valuable indicator of the overall health of the marine environment. The causes of this decline are currently unclear. To better understand the observed decline and to potentially effect changes that may reverse this situation all available collected data should be utilized. The development of the Cherry Point herring stock spawn deposition survey spatial and temporal database provides greatly improved tools to illustrate changes and trends in herring spawning behavior and stock size.

Additional work should include database development to include herring spawn deposition survey data that are available from other Washington stocks. Completion of this work would require an increase in current funding.

Acknowledgements

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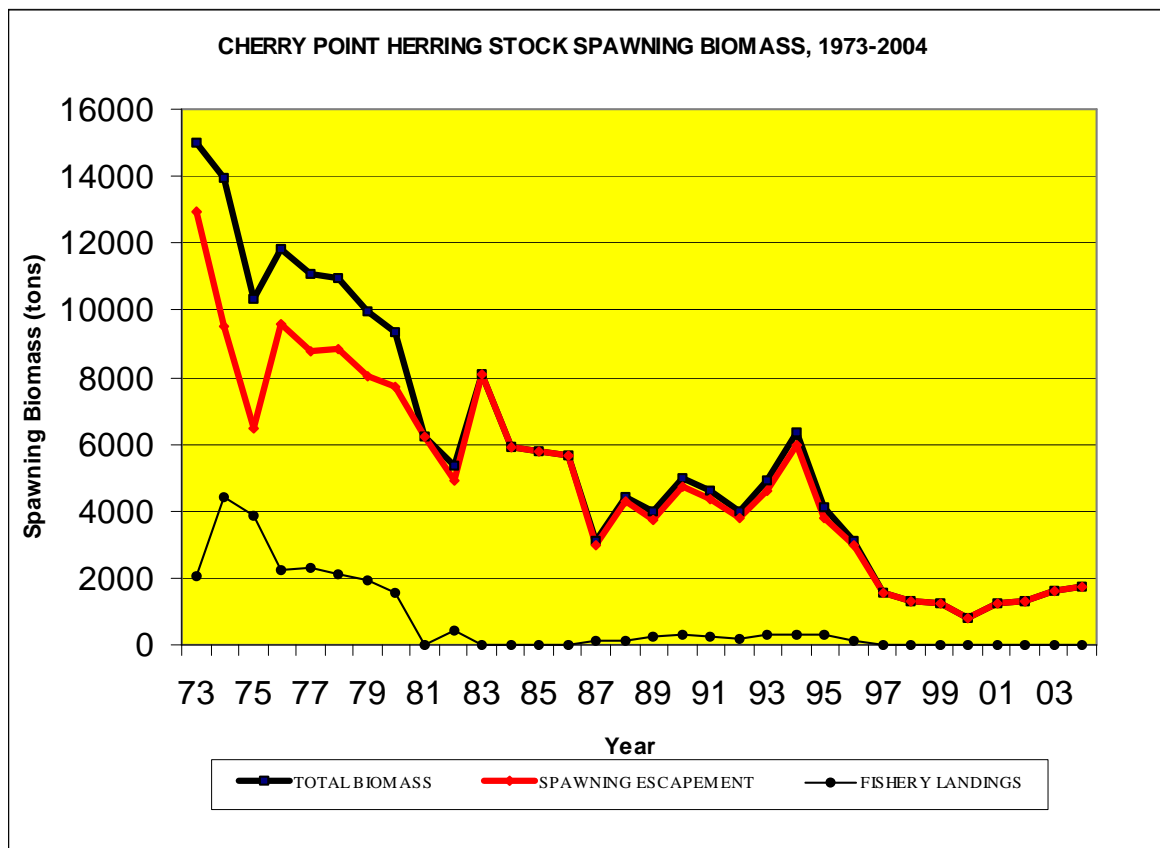


Figure 1. Cherry Point, Washington herring stock spawning biomass, 1973-2004.

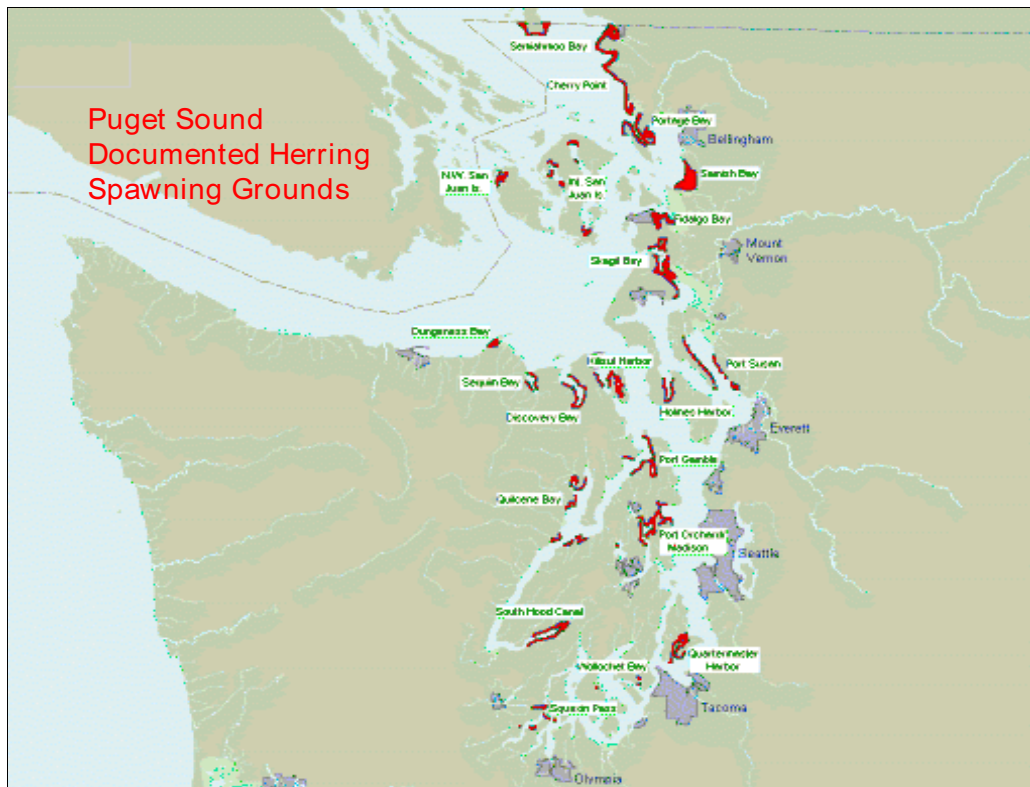


Figure 2. Documented herring spawning grounds for Puget Sound, Washington.



Figure 3. Documented spawning grounds for Cherry Point, WA herring stock.

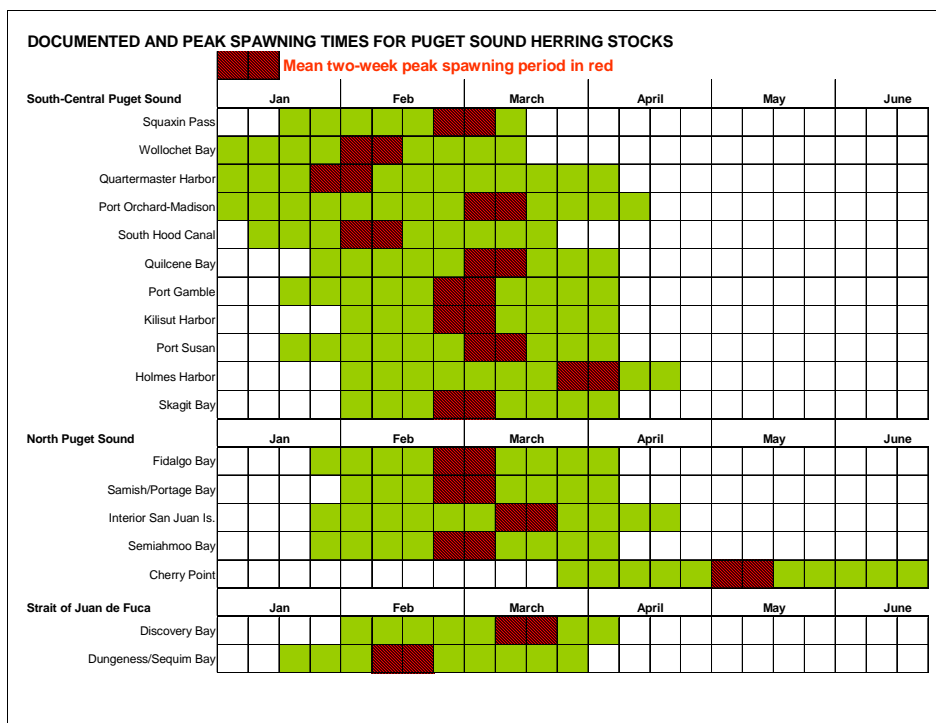


Figure 4. Documented spawning timing for Puget Sound herring stocks.



Figure 5. Location of amount of estimated spawning escapement for Cherry Point herring stock, 1973-1980.



Figure 6. Location of amount of estimated spawning escapement for Cherry Point herring stock, 1981-1988.



Figure 7. Location of amount of estimated spawning escapement for Cherry Point herring stock, 1989-1996.

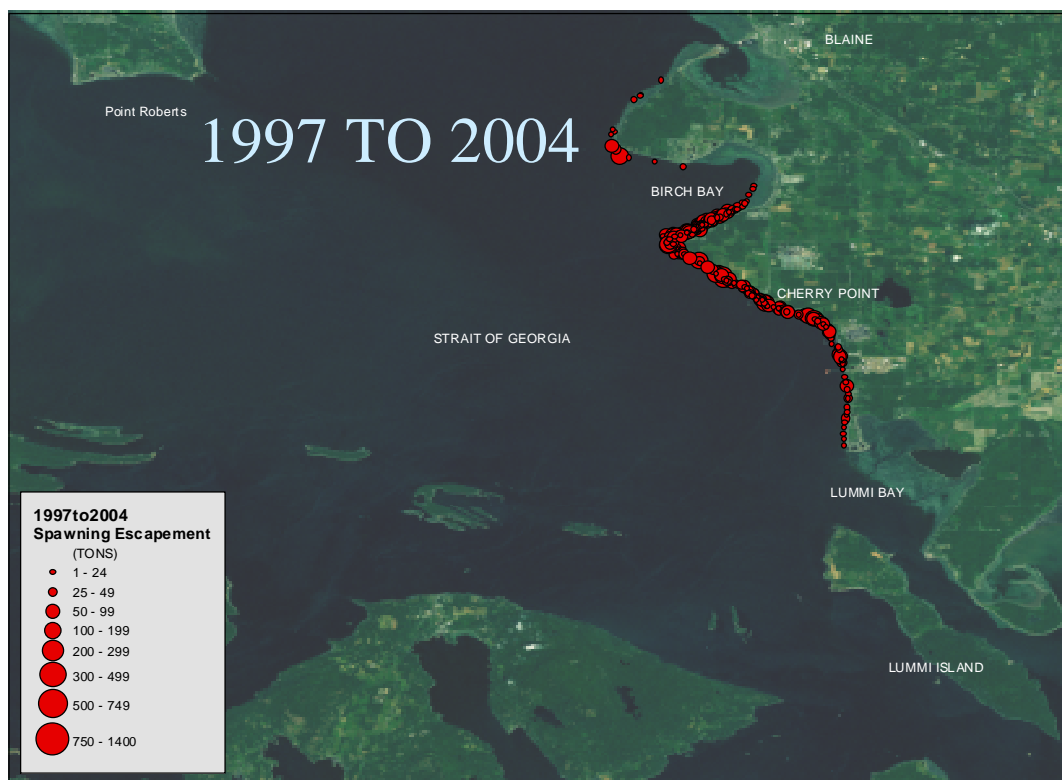


Figure 8. Location of amount of estimated spawning escapement for Cherry Point herring stock, 1997-2004.